

Units 1 + 2 Review Answers

1. - Dalton =
- particles that compose matter are small hard spheres - named them atoms
 - atom is indestructible + indivisible
 - atoms of same element are identical, those of different atoms are different.
 - law of conservation of mass = mass of products equal mass of reactants
 - law of definite proportions = samples of a compound will always have the same proportion of elements by mass
 - law of multiple proportions = the mass of elements combine in small whole # ratios forming compounds.

- Thomson = (J.J)
- discovered the electron with a cathode ray tube
 - when positive pole of magnet (external field) was placed near the tube, path of ray curved/deflected towards the pole — indicating rays are negatively charged
 - proved every elemental atoms can be made to emit tiny negative particles, so all atoms must have them
 - knew atoms didn't have a negative charge, so something else must be balancing the charge of electrons.

- (William)
- proposed plum pudding model
 - atoms consist of small negative electrons embedded in massive positive sphere.

- Rutherford =
- nuclear/planetary model
 - fired alpha particles (helium nucleus) at thin gold foil.
 - suspected α particles to be only slightly deflected based the established

Thomson model (\oplus charges are spread out + \therefore weak).

- discovered some α were deflected at very large angles, but most went through — disproved the Thomson model
- proposed all of an atom's positive charge + most of its mass were confined to small dense centered region named the nucleus, + e^- float around nucleus, + atom is mostly empty space.
- explanation of experiment =
 - straight through = alpha hit nothing
 - slight deflection = α came close to nucleus
 - large deflection = α directly hit nucleus

- Bohr =

- wanted to discover why nuclear model defied physics.
- reasoned through the work of Planck + Einstein that total energy of each e^- is quantized — can only absorb or emit energy in an all-or-none manner.
- e^- can only exist in certain regions of space called orbits ("energy levels").
- e^- closer to nucleus are at lower energy levels + are more stable.
- e^- do not emit energy while in one orbital
- e^- can jump between orbitals by absorbing or emitting the exact amount of energy as the energy difference between orbitals — giving rise to spectra.
- calculated radii + energy of orbits in hydrogen atom.

- Quantum Mechanics =

- describes e^- as waves
- e^- have discrete energies because they can only have certain wavelengths (e^- are standing waves \therefore have fixed nodes).

- line spectra is due to e^- transitioning from one wavelength to another
- atomic orbital = region in space related to a specific wave function
- wave functions can determine the probability of finding an e^- within the space described by the function (Max Born)
- not possible to know precisely the position + momentum of a particle = Heisenberg Uncertainty Principle.
- quantum #s describe e^- in an atom
- n describes orbital's energy level + relative size
- l describes orbital shape
- m_l describes orbital orientation in space
- m_s describes behaviour (spin) of an e^- in an orbital.

2. $\rightarrow n$ = the principle quantum #

- ranges from 1 to infinity
- relative to size of e^- wave

$\rightarrow l$ = orbital shape quantum #

- refers to energy sublevels/subshells within each orbit.

- ranges, in integers, from 0 to $n-1$

- $l=0$ (s), $l=1$ (p), $l=2$ (d), $l=3$ (f)

$\rightarrow m_l$ = magnetic quantum #

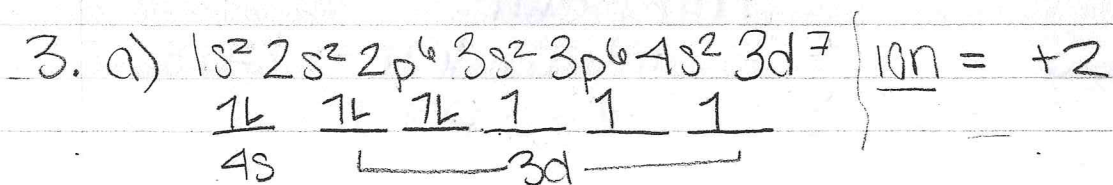
- further divides subshells into orbitals

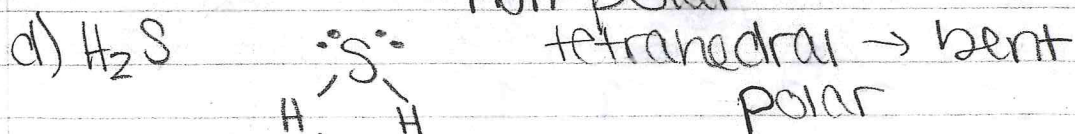
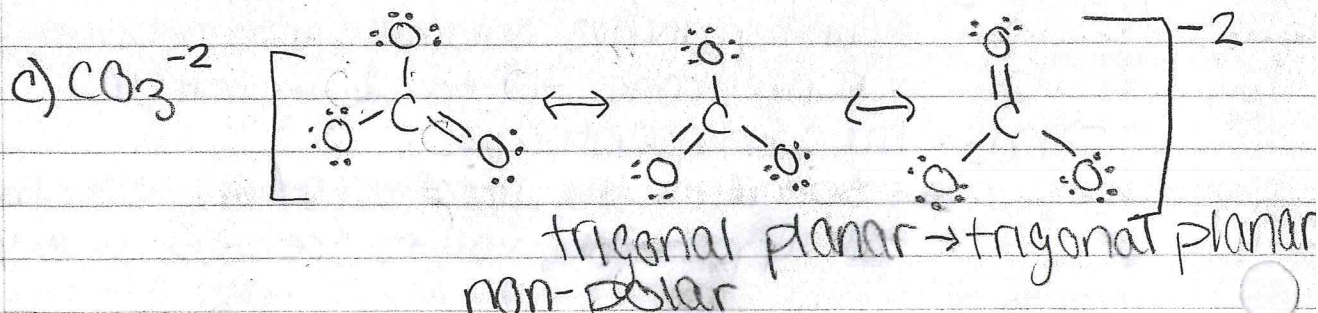
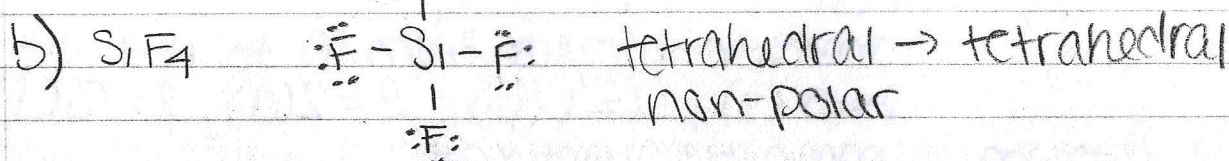
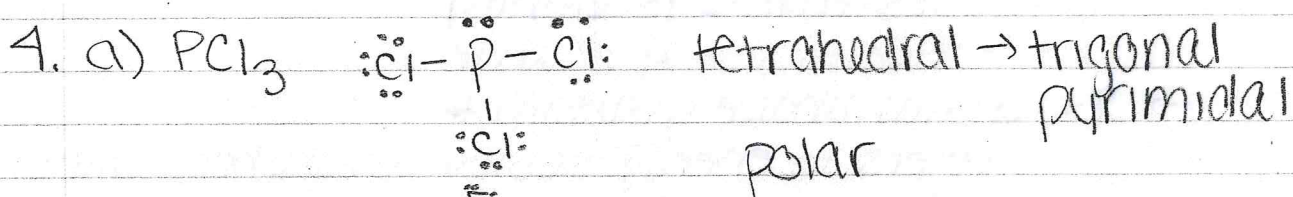
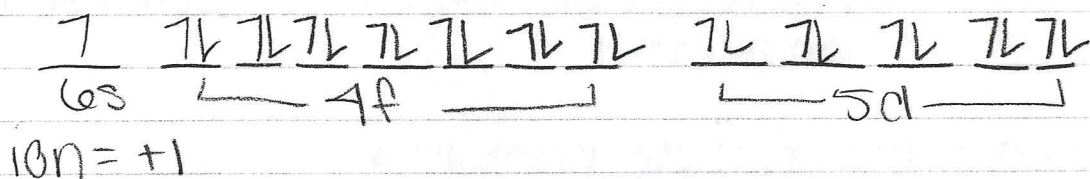
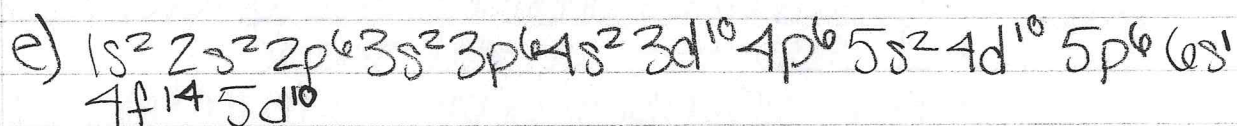
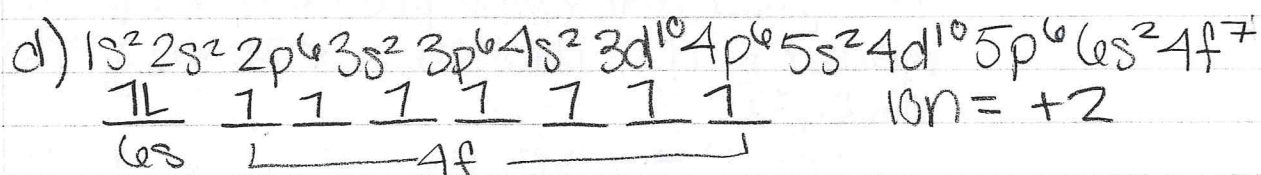
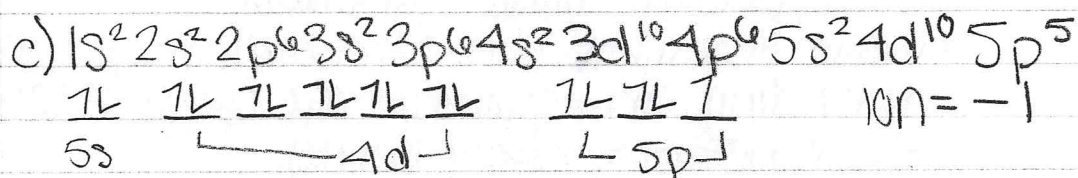
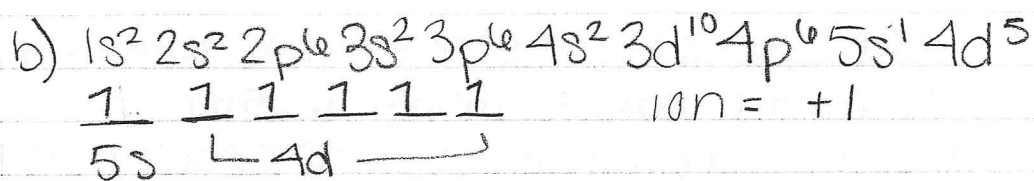
- range from $-l$ to l , in integers.

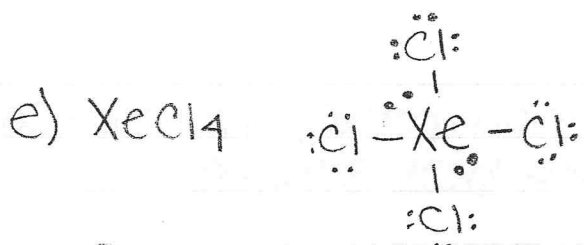
$\rightarrow m_s$ = the spin quantum #

- specifies the direction of an e^- 's axis

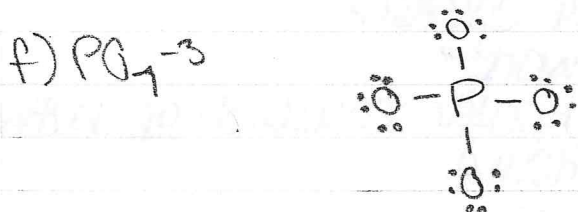
- only possible values are $-1/2$ and $1/2$



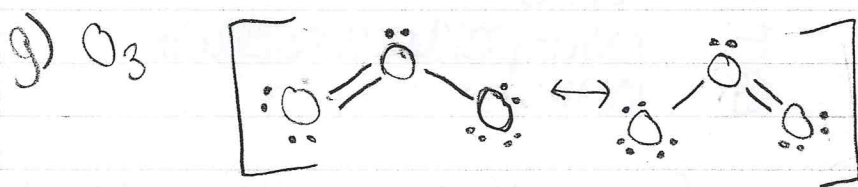




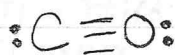
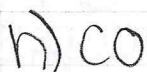
octahedral \rightarrow square planar
non-polar



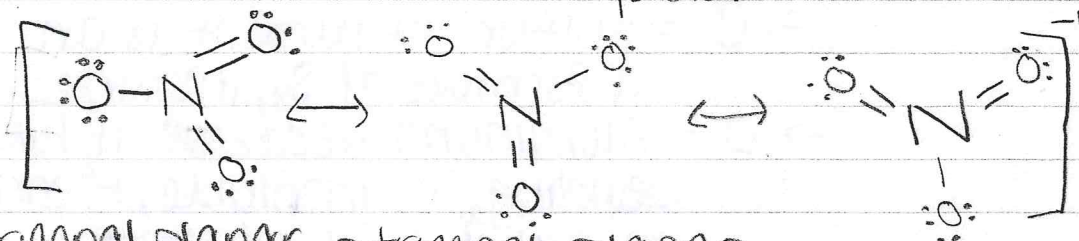
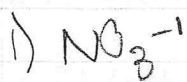
tetrahedral \rightarrow tetrahedral
non-polar



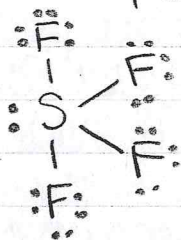
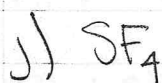
trigonal planar \rightarrow bent
polar



linear
polar



trigonal planar \rightarrow trigonal planar
non-polar



trigonal bipyramidal \rightarrow seesaw
polar

5. Fluoromethane would have a higher BP. Methane is a non-polar molecule so only has London dispersion intermolecular forces. Fluoromethane is a polar molecule so has dipole-dipole intermolecular forces as well as London dispersion. Stronger IMF means higher BP.

6. Tetrachloromethane. Water is a polar molecule, tetrachloromethane is a non-polar molecule (has polar bonds, but symmetrical so non-polar molecule). Like dissolves

like so since $I_2(g)$ is non-polar, the non-polar tetrachloromethane is the best solvent.

7. Substance →
- | | |
|---|-------------------------------|
| A | polar covalent |
| B | network |
| C | non-polar covalent or network |
| D | metallic |
| E | ionic |
| F | non-polar covalent |
| G | ionic |

b) Substance → A = methanol because it is polar with its $-OH$ group, soluble, and a poor conductor.

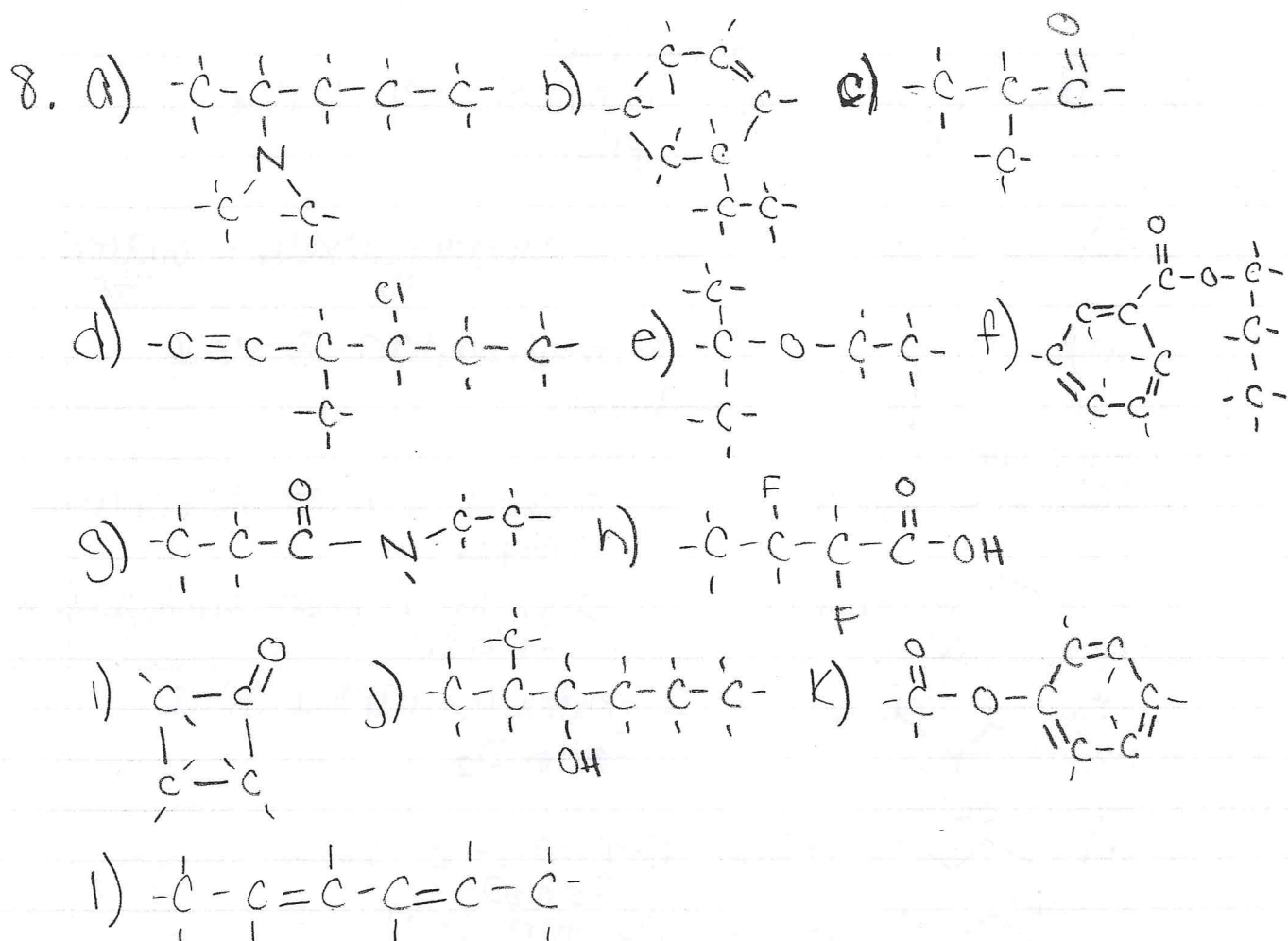
→ C = sulfur because it is an allotrope having a formula of S_8 , insoluble.

→ D = Aluminum because it has metallic bonding, is insoluble, + conducts electricity in solid + liquid state.

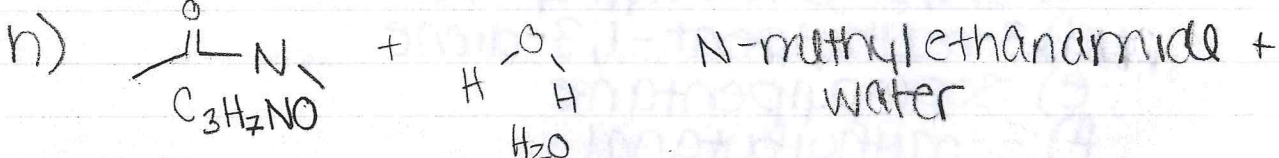
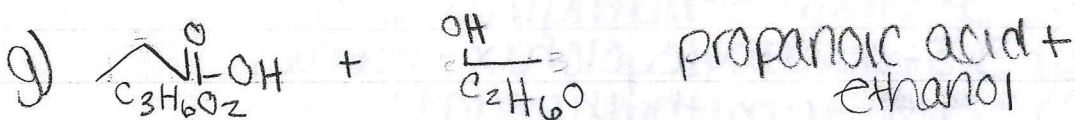
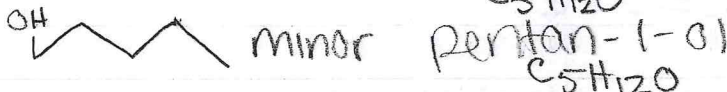
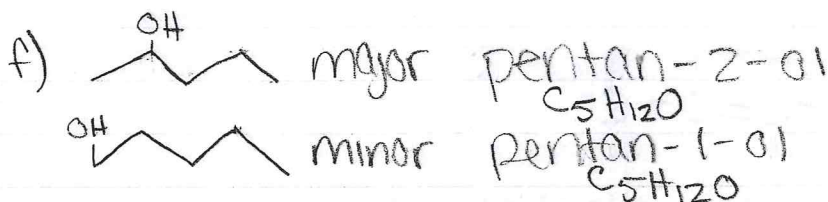
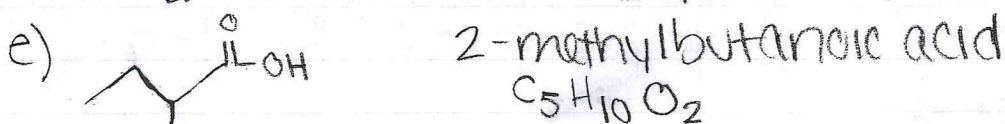
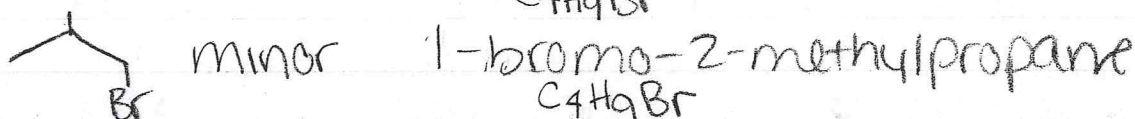
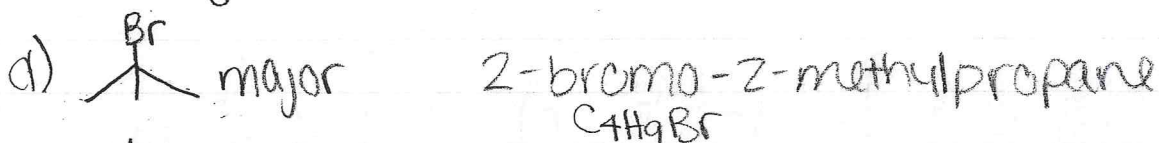
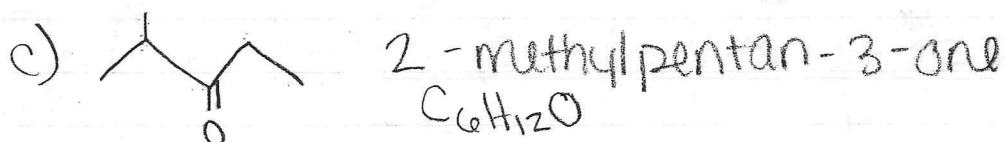
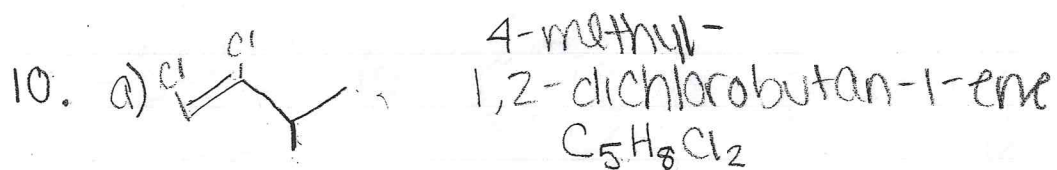
→ E = Potassium Chloride because it has ionic bonding, is soluble, conducts electricity in aqueous + liquid form.

→ F = Methane because it has non-polar covalent bonding, is insoluble, + is a poor conductor.

→ G = Calcium oxide because is slightly soluble, conducts electricity as a liquid and slightly in water, + has ionic bonding. The larger charge on anion + cation makes the MP + BP higher than that for substance E (CaO) because IMF are so stronger. The larger charge value also makes it only slightly soluble + ability to conduct electricity slightly as the stronger forces of attraction within the lattice are more difficult for water to overcome (break bonds between lattice).



9. a) 3-ethyl-4-methylhex-2-ene
b) 3,5-dimethylcyclohex-1-ene
c) 3,4,5-trimethylheptane
d) 3-methylpent-1,3-diene
e) isopropylpentane
f) 3-methylbutanal
g) cyclopent-1,3-dien-5-ol or 5-hydroxycyclopent-1,3-diene
h) cyclohexanone
i) 1,3-dichlorobenzene
j) butan-1,3-diol
k) 1-ethoxypropane
l) methyl propanoate
m) hexan-2-one
n) butanoic acid
o) ethyl benzoate
p) N-methyl-3-methylbutan-2-amine
q) N-ethyl-N-methyl-2,4-dimethylpentan-3-amine
r) N-isopropylbutanamide



11. a) IMF:

b) \downarrow

- propanone = DD, LD - slightly soluble
- propan-2-ol = HB, DD, LD - soluble (very)
- 2-chloropropane = DD, LD - slightly soluble
- propanoic acid = HB, DD, LD - soluble (very)
- propane = LD - insoluble

